

MIL-M-38510/318A
9 August 1983
SUPERSEDING
MIL-M-38510/318(USAF)
20 April 1979

MILITARY SPECIFICATION

MICROCIRCUITS, DIGITAL, LOW POWER SCHOTTKY TTL,
BINARY MULTIPLIER, MONOLITHIC SILICON

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for monolithic silicon, low-power Schottky TTL, binary multiplier, logic microcircuits. Two product assurance classes and a choice of case outlines and lead finishes are provided and are reflected in the complete part number.

1.2 Part number. The part number shall be in accordance with MIL-M-38510, and as specified herein.

1.2.1 Device type. The device type shall be as follows:

<u>Device type</u>	<u>Circuit</u>
01	2-bit by 4-bit parallel binary multiplier

1.2.2 Device class. The device class shall be the product assurance level as defined in MIL-M-38510.

1.2.3 Case outline. The case outline shall be designated as follows:

<u>Outline letter</u>	<u>Case outline (see MIL-M-38510, appendix C)</u>
E	D-2 (16-lead, 1/4" x 7/8"), dual-in-line package
F	F-5 (16-lead, 1/4" x 3/8"), flat package
X	C-2 (20 terminal .350" x .350"), square chip carrier package

1.3 Absolute maximum ratings.

Supply voltage range	- - - - -	-0.5 V dc to +7.0 V dc
Input voltage range	- - - - -	-1.5 V dc at -18 mA to +5.5 V dc
Storage temperature range	- - - - -	-65°C to +150°C
Maximum power dissipation (P _D) 1/	- - - - -	209 mW
Lead temperature (soldering, 10 seconds)	- - - - -	+300°C
Thermal resistance, junction-to-case (θ _{JC}):		
Case E	- - - - -	50°C/W
Case F	- - - - -	70°C/W
Case X	- - - - -	60°C/W
Junction temperature (T _J)	- - - - -	+175°C

1/ Must withstand the added P_D due to short circuit test (e.g., I_{OS}).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Air Development Center (RBE-2), Griffiss AFB, NY 13441, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Recommended operating conditions.

t_{SETUP} B to G^{\downarrow}	- - - - -	25 ns
t_{SETUP} M to G^{\downarrow}	- - - - -	17 ns
Supply voltage (V_{CC})	- - - - -	4.5 V dc minimum to 5.5 V dc maximum
Minimum high-level input voltage (V_{IH})	- - - - -	2.0 V dc
Maximum low-level input voltage (V_{IL})	- - - - -	0.7 V dc
Normalized fanout (each output)	- - - - -	10 maximum
t_{HOLD} B or M to G^{\downarrow}	- - - - -	0 ns
Case operating temperature range (T_C)	- - - - -	-55°C to +125°C
Enable pulse width	- - - - -	25 ns

2. APPLICABLE DOCUMENTS

2.1 Government specifications and standards. Unless otherwise specified, the following specifications and standards, of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATION**MILITARY**

MIL-M-38510 - Microcircuits, General Specification for.

STANDARD**MILITARY**

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Detail specification. The individual item requirements shall be in accordance with MIL-M-38510, and as specified herein.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein.

3.2.1 Terminal connections and logic diagrams. The terminal connections and logic diagrams shall be as specified on figures 1 and 3, respectively.

3.2.2 Truth table. The truth table shall be as specified on figure 2.

3.2.3 Schematic circuits. The schematic circuits shall be submitted to the preparing activity prior to inclusion of a manufacturer's device in this specification and shall be submitted to the qualifying activity as a prerequisite for qualification. All manufacturers' schematics shall be maintained and available upon request.

3.2.4 Case outlines. The case outlines shall be as specified in 1.2.3.

3.3 Lead material and finish. The lead material and finish shall be in accordance with MIL-M-38510 (see 6.5).

3.4 Electrical performance characteristics. The electrical performance characteristics are as specified in table I, and apply over the full recommended case operating temperature range, unless otherwise specified.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions $-55^{\circ}\text{C} \leq T_{\text{C}} \leq +125^{\circ}\text{C}$	Device type	Limits		Unit
				Min	Max	
High-level output voltage	V _{OH}	V _{CC} = +4.5 V; I _{OH} = -0.4 mA	01	2.5		V
Low-level output voltage	V _{OL}	V _{CC} = +4.5 V; I _{OL} = +4.0 mA;	01		0.40	V
Input clamp voltage	V _{IC}	V _{CC} = +4.5 V; I _{IN} = -18 mA; T _C = +25°C	01		-1.5	V
Low-level input current at all inputs, except M0, M1, G	I _{IIL1}	V _{CC} = +5.5 V; V _{IN} = +0.4 V	01	-30	-600	μA
Low-level input current M0, M1	I _{IIL2}	V _{CC} = 5.5 V; V _{IN} = 0.4 V	01	-60	-720	μA
Low-level input current G	I _{IIL3}		01	-160	-600	μA
High-level input current at all inputs except M0 or M1	I _{IH1}	V _{CC} = 5.5 V; V _{IN} = 2.7 V	01		20	μA
	I _{IH2}	V _{CC} = 5.5 V; V _{IN} = 5.5 V	01		100	μA
High-level input current at M0 or M1	I _{IH3}	V _{CC} = 5.5 V; V _{IN} = 2.7 V	01		40	μA
	I _{IH4}	V _{CC} = 5.5 V; V _{IN} = 5.5 V	01		200	μA
Short-circuit output current	I _{OS}	V _{CC} = +5.5 V; V _{OUT} = GND 1/	01	-15	-100	mA
Supply current	I _{CC}	V _{CC} = 5.5 V; V _{IN} = GND	01		38	mA
Propagation delay time, low to high-level output from enable	t _{PLH1}	V _{CC} = 5.0 V; R _L = 2 kΩ ±5%; C _L = 50 pF ±10%	01	2	52	ns
Propagation delay time, high to low-level output from enable	t _{PHL1}		01	2	46	ns

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions $-55^{\circ}\text{C} \leq T_C \leq +125^{\circ}\text{C}$	Device type	Limits		Unit
				Min	Max	
Propagation delay time, low to high-level output from any M	tPLH2	V _{CC} = 5.0 V; R _L = 2 kΩ ±5% C _L = 50 pF ±10%	01	2	58	ns
Propagation delay time, high to low-level output from any M	tPHL2		01	2	52	ns
Propagation delay time, low to high-level output from any B	tPLH3		01	2	61	ns
Propagation delay time, high to low-level output from any B	tPHL3		01	2	55	ns

1/ Not more than one output should be shorted at a time.

3.5 Electrical test requirements. The electrical test requirements for each device class shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table III.

3.6 Marking. Marking shall be in accordance with MIL-M-38510. At the option of the manufacturer, marking of the country of origin may be omitted from the body of the microcircuit, but shall be retained on the initial container.

3.7 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 11 (see MIL-M-38510, appendix E).

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (see table III)	
	Class S devices	Class B devices
Interim electrical parameters (pre burn-in) (method 5004)	1	1
Final electrical test parameters (method 5004)	1*, 2, 3, 7, 9, 10, 11	1*, 2, 3, 7, 9
Group A test requirements (method 5005)	1, 2, 3, 7, 8, 9, 10, 11	1, 2, 3, 7, 9, 10, 11
Group B test requirements (method 5005) subgroup 5	1, 2, 3, 7, 8, 9, 10, 11	N/A
Group C end-point electrical parameters (method 5005)	N/A	1, 2, 3
Additional electrical subgroups for group C periodic inspections	N/A	N/A
Group D end-point electrical parameters (method 5005)	1, 2, 3	1, 2, 3

*PDA applies to subgroup 1 (see 4.2c).

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-M-38510 and methods 5005 and 5007, as applicable, of MIL-STD-883, except as modified herein.

4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to qualification and quality conformance inspection. The following additional criteria shall apply:

a. Burn-in test (method 1015 of MIL-STD-883).

- (1) Test condition D or E, using the circuit shown on figure 4, or equivalent.
- (2) $T_A = +125^\circ\text{C}$ minimum.

b. Interim and final electrical tests shall be as specified in table II, except interim electrical tests prior to burn-in are optional at the discretion of the manufacturer.

c. The percent defective allowable (PDA) for class S devices shall be as specified in MIL-M-38510. The PDA for class B devices shall be 10 percent based on failures from group A, subgroup 1 tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883, and with no intervening electrical measurements. If interim electrical tests are performed prior to burn-in, failures resulting from pre burn-in screening may be excluded from the PDA. If interim electrical tests prior to burn-in are omitted, then all screening failures shall be included in the PDA. The verified failures of group A, subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent defective for that lot, and the lot shall be accepted or rejected based on the PDA for the applicable device class.

4.3 Qualification inspection. Qualification inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-M-38510 and as specified herein. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.4.1 Group A inspection. Group A inspection shall be in accordance with table I of method 5005 of MIL-STD-883 and as follows:

a. Tests shall be as specified in table II.

b. Subgroups 4, 5, and 6 shall be omitted.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of method 5005 of MIL-STD-883. Electrical parameters shall be as specified in table II.

4.4.3 Group C inspection. Group C inspection shall be in accordance with table III of method 5005 of MIL-STD-883 and as follows:

a. End-point electrical test parameters shall be as specified in table II herein.

b. Steady-state life test (method 1005 of MIL-STD-883) conditions:

(1) Test condition D or E, using the circuit shown on figure 4, or equivalent.

(2) $T_A = +125^{\circ}\text{C}$ minimum.

(3) Test duration: 1,000 hours, except as permitted by appendix B of MIL-M-38510 and method 1005 of MIL-STD-883.

4.4.4 Group D inspection. Group D inspection shall be in accordance with table IV of method 5005 of MIL-STD-883. End-point electrical parameters shall be as specified in table II.

4.5 Methods of inspection. Methods of inspection shall be specified as follows.

4.5.1 Voltage and current. All voltages given are referenced to the microcircuit ground terminal. Currents given are conventional and positive when flowing into the referenced terminal.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging of microcircuits shall be in accordance with MIL-M-38510.

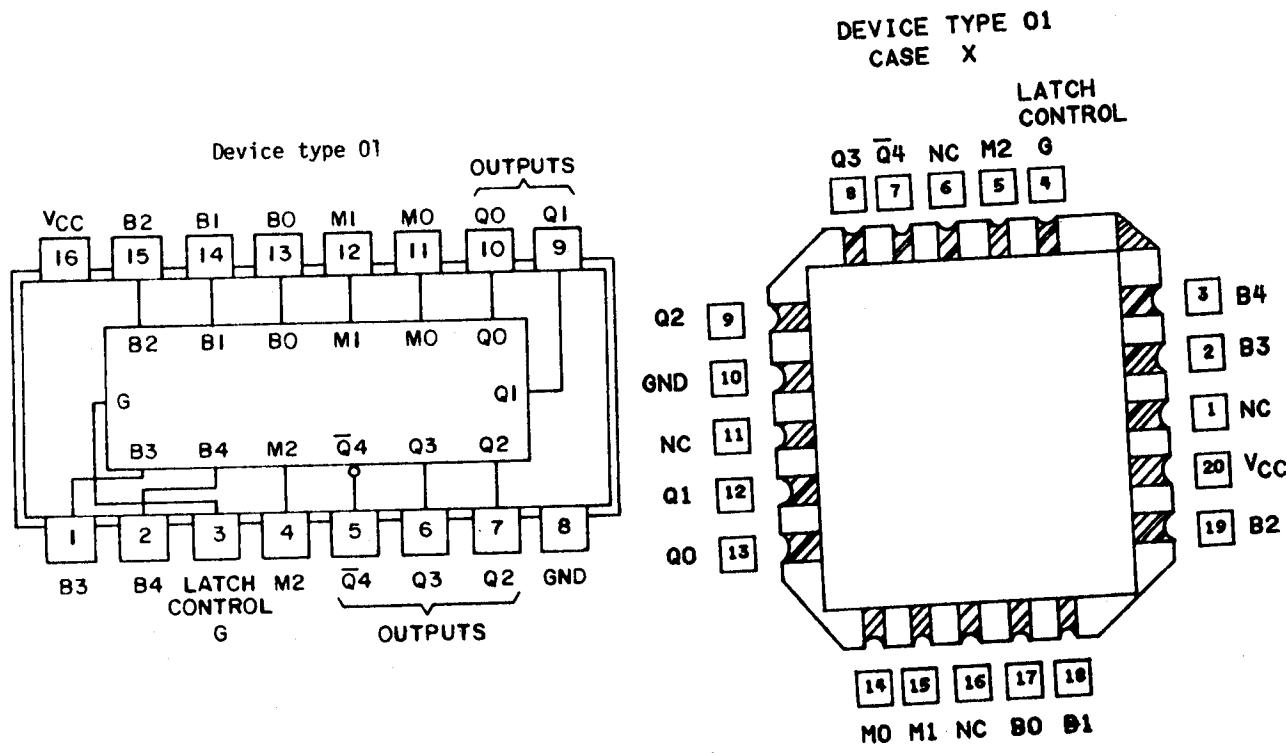


FIGURE 1. Terminal connections.

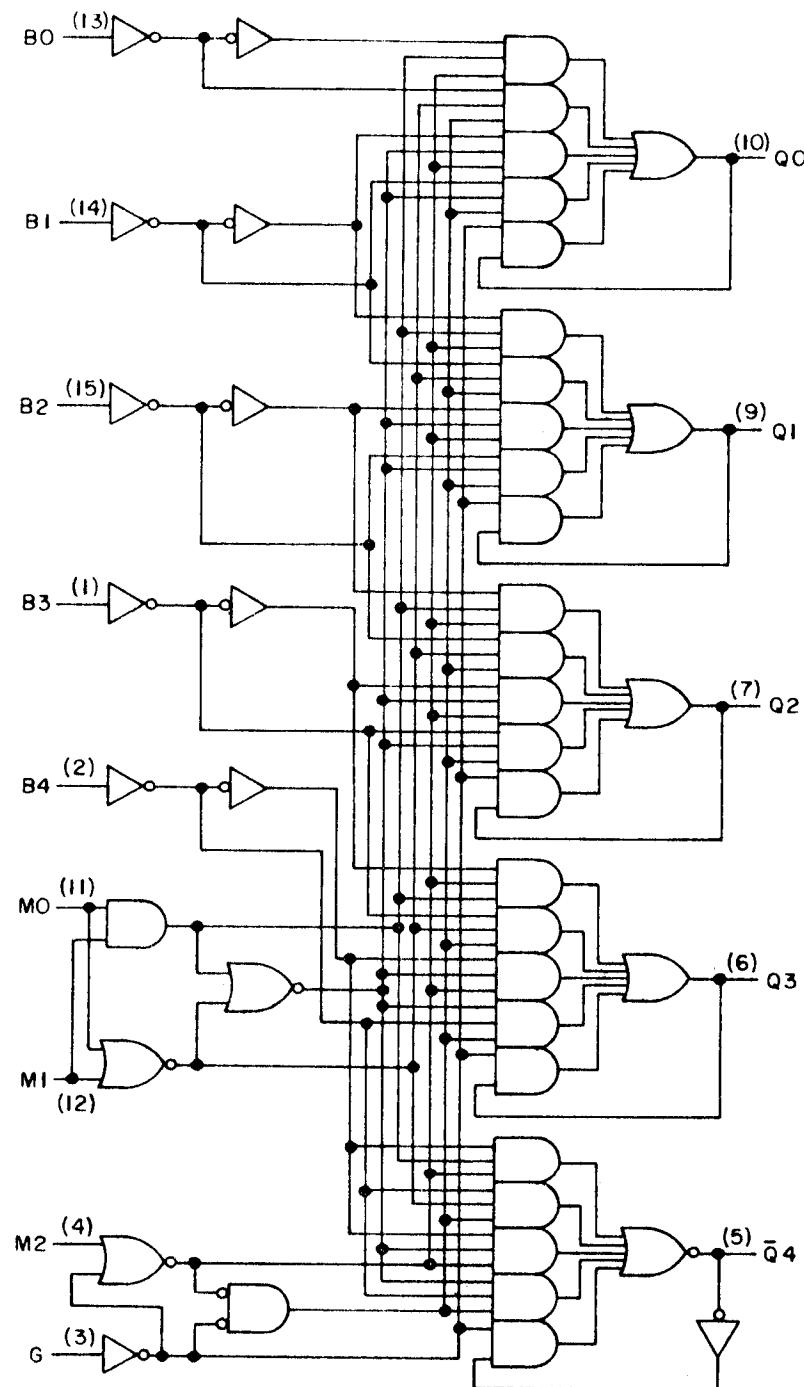
Device type 01

Inputs			Outputs					
Latch control G	Multiplier			\bar{Q}_4	Q3	Q2	Q1	Q0
	M2	M1	MO					
	L	X	X	X	\bar{Q}_4 ₀	Q3 ₀	Q2 ₀	Q1 ₀
H	L	L	L	H	L	L	L	L
H	L	L	H	\bar{B}_4	B4	B3	B2	B1
H	L	H	L	\bar{B}_4	B4	B3	B2	B1
H	L	H	H	\bar{B}_4	B3	B2	B1	BO
H	H	L	L	B4	\bar{B}_3	\bar{B}_2	\bar{B}_1	BO
H	H	L	H	B4	\bar{B}_4	\bar{B}_3	\bar{B}_2	\bar{B}_1
H	H	H	L	B4	\bar{B}_4	\bar{B}_3	\bar{B}_2	\bar{B}_1
H	H	H	H	H	L	L	L	L

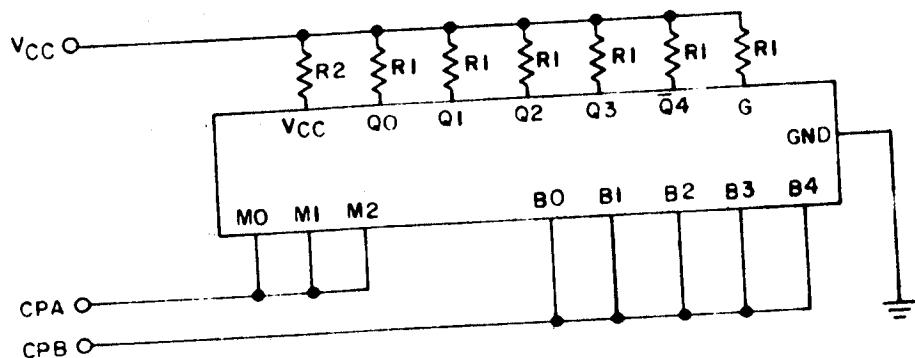
 $H = \text{high level}, L = \text{low level}, X = \text{irrelevant}.$ $\bar{Q}_4 \dots Q_0 = \text{The logic level of the same output before the high-to-low transition of } G.$ $B4 \dots B0 = \text{The logic level of the indicated multiplicand (B) input.}$

FIGURE 2. Truth table.

Device type 01

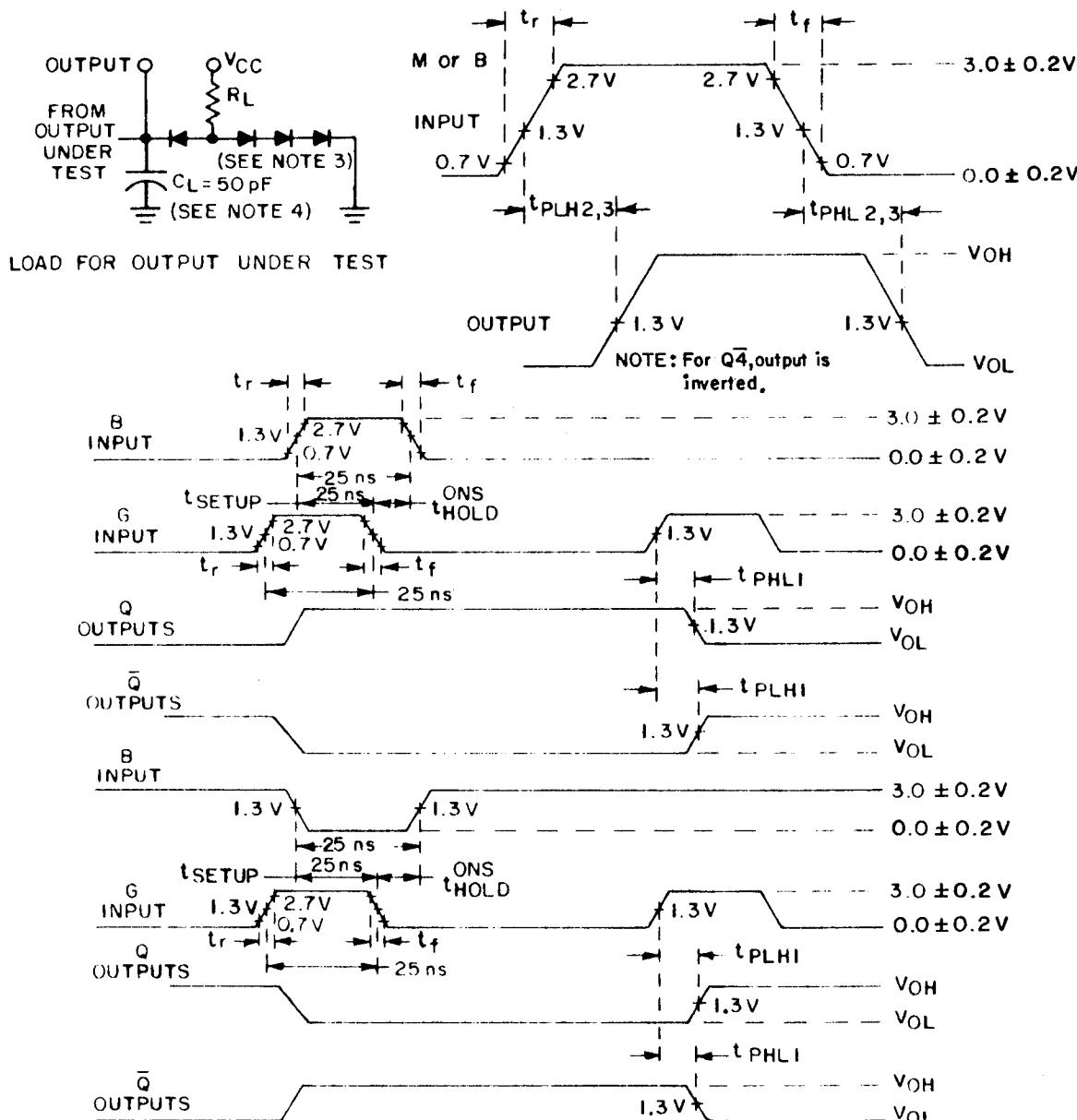
FIGURE 3. Logic diagram .

Device type 01



- NOTES:
1. CPA = 100 kHz \pm 50% square wave; duty cycle = 50 \pm 15%; V_{IL} = -0.5 V minimum to +0.7 V maximum; V_{IH} = 2.0 V minimum to 5.5 V maximum.
 2. CPB = Same as CPA, synchronized with CPA, except 50 kHz \pm 50% square wave.
 3. V_{CC} shall be high enough to insure that 5.0 V minimum is present at V_{CC} device terminal.

FIGURE 4. Burn-in and life test circuit.

**NOTES:**

1. Input pulse characteristics: PRR $\leq 1.0 \text{ MHz}$, $t_r \leq 15 \text{ ns}$, and $t_f \leq 6 \text{ ns}$.
2. $C_L = 50 \text{ pF} \pm 10\%$ including probe and jig capacitance.
3. $R_L = 2.0 \text{ k}\Omega \pm 5\%$. All diodes are 1N3064 or 1N916.
4. Load circuit on a given output is only required where the specific test in table III indicates "OUT" on that output.

FIGURE 5. Switching test for device type 01.

TABLE III. Group A inspection for device type 01.
Terminal conditions (pins not designated may be high ≥ 2.0 V or low ≤ 0.7 V or open).

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TABLE III. Group A inspection for device type 01 - Continued.
Terminal conditions (pins not designated may be high ≥ 2.0 V or low ≤ 0.7 V or open).

Subgroup	Symbol	MIL-STD-883-C method	Cases E,F	Terminal conditions (pins not designated may be high ≥ 2.0 V or low ≤ 0.7 V or open).																Measured terminal	Limits		
				Test no.	B3	B4	G	M2	Q4	Q3	Q2	GND	Q1	Q0	M0	Q1	Q0	M0	Q1	Q0	M0		
$T_C = +25^\circ C$	I1H2	3010	41									GND									5.5 V	M2	100 μA
		"	42									"									"	G	"
		"	43									"									"	B1	"
		"	44									"									"	B2	"
		"	45									"									"	B3	"
		"	46									"									"	B4	"
		"	47									"									"		
	I1H3	"	48									"									"	M0	40
		"	49									"									"	N1	40
	I1H4	"	50									"									"	M0	200
		"	51									"									"	M1	200
	ICC	3005	52									GND									"	VCC	38 mA
												"									"		
												"									"		
												"									"		
2	Same tests, terminal conditions, and limits as for subgroup 1, except $T_C = +125^\circ C$ and VIC tests are omitted.																						
3	Same tests, terminal conditions, and limits as for subgroup 1, except $T_C = -55^\circ C$ and VIC tests are omitted.																						
$T_C = +25^\circ C$	7	Truth table tests	3014 2/	53	A	A	A	A	A	A	A	GND	L	L	L	H	H	H	B	A	A	5.0 V	
		"	54	"								"											"
		"	55	"								"											
		"	56	"								"											
		"	57	"								"											
8	Same tests, terminal conditions, and limits as for subgroup 7, except $T_C = +125^\circ C$ and $T_C = -55^\circ C$.																						
$T_C = +25^\circ C$	9	tPLH1	3003 Fig. 5	71								GND				OUT	OUT	OUT	5.0 V	IN	IN	5.0 V	G to 00
		"	72									"				OUT	OUT	OUT	"			"	G to 01
		"	73									"				OUT	OUT	OUT	"			"	G to 02
		"	74									"				OUT	OUT	OUT	"			"	G to 03
		"	75									"				OUT	OUT	OUT	"			"	G to 04

TABLE III. Group A inspection for device type 01 - Continued.
Terminal conditions (pins not designated may be high ≥ 2.0 V or low ≤ 0.7 V or open).

Subgroup	Symbol	Cases STD-883-C method X	terminal conditions (pins not designated may be omitted)												Measured terminal		Limits	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
9 $T_C = +25^\circ C$	tPHL2	3003 F19	84 85	84 86	5.0 V " " "	GND GND IN	M2 " "	Q4 " "	Q3 " "	Q2 " "	GND " "	Q1 " "	Q0 " "	M0 " "	B0 " "	B1 " "	B2 " "	VCC " "
	tPLH3	"	87 88 89 90 91	"	"	GND " "	"	"	"	"	GND " "	"	"	OUT " "	IN " "	IN " "	IN " "	5.0 V " "
	tPHL3	"	92 93 94 95 96	"	"	"	"	"	"	"	"	"	"	OUT " "	IN " "	IN " "	IN " "	5.0 V " "
10 $T_C = +125^\circ C$	tPHL1	"	97	"	"	"	"	"	"	"	"	"	"	OUT " "	IN " "	IN " "	IN " "	5.0 V " "
	tPHL1	"	98	"	"	"	"	"	"	"	"	"	"	OUT " "	IN " "	IN " "	IN " "	5.0 V " "
	tPLH2	"	99	"	"	"	"	"	"	"	"	"	"	OUT " "	IN " "	IN " "	IN " "	5.0 V " "
	tPLH3	"	100	"	"	"	"	"	"	"	"	"	"	OUT " "	IN " "	IN " "	IN " "	5.0 V " "
	tPHL3	"	101	"	"	"	"	"	"	"	"	"	"	OUT " "	IN " "	IN " "	IN " "	5.0 V " "
	tPLH3	"	102	"	"	"	"	"	"	"	"	"	"	OUT " "	IN " "	IN " "	IN " "	5.0 V " "

same effects terminal conditions and limits as for subgroup 10, except $C = -55$ L.

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Cases X and Y pins not referenced are NC.
 1/ Inputs: A > 2.0 V, B < 0.7 V
 2/ Outputs: Output voltages shall be either:
 3/ a. H = 2.5 volts minimum and L = 0.4 volts maximum when using a high speed checker double comparator, or
 b. H = 1.5 volts and L = 0.15 volts when using a high speed checker single comparator.
 4/ Afterfitting data only is required for subgroups 7 and 8.

c. All limits in HA are as follows:

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-120/-360/-600

MIN/max limits for CKT

Min/max times for CTK	
	B
A	
-120/-360	-30/-300

Min/max limits for CKT	
	B
A	
-240/-720	-60/-600

6. NOTES

6.1 Notes. The notes specified in MIL-M-38510 are applicable to this specification.

6.2 Intended use. Microcircuits conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.3 Ordering data. The acquisition document should specify the following:

- a. Complete part number (see 1.2).
 - b. Requirements for delivery of one copy of the quality conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
 - c. Requirements for certificate of compliance, if applicable.
 - d. Requirements for notification of change of product or process to the contracting activity in addition to notification to the qualifying activity, if applicable.
 - e. Requirements for failure analysis (including required test condition of method 5003 of MIL-STD-883), corrective action, and reporting of results, if applicable.
 - f. Requirements for product assurance options.
 - g. Requirements for special carriers, lead lengths, or lead forming, if applicable, these requirements shall not affect the part number. Unless otherwise specified, these requirements shall not apply to direct purchase by or direct shipment to the Government.
 - h. Requirements for "JAN" marking.

6.4 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-M-38510, MIL-STD-1331, and as follows:

6.5 Logistic support. Lead materials and finishes (see 3.3), are interchangeable. Unless otherwise specified, microcircuits acquired for Government logistic support will be acquired to device class B (see 1.2.2), and lead material and finish C (see 3.3). Longer length leads and lead forming shall not affect the part number.

6.6 Substitutability. The cross-reference information below is presented for the convenience of users. Microcircuits covered by this specification will functionally replace the listed generic-industry type. Generic-industry microcircuit types may not have equivalent operational performance characteristics across military temperature ranges or reliability factors equivalent to MIL-M-38510 device types and may have slight physical variations in relation to case size. The presence of this information shall not be deemed as permitting substitution of generic-industry types for MIL-M-38510 types or as a waiver of any of the provisions of MIL-M-38510.

<u>Military device type</u>	<u>Generic-industry type</u>
01	54LS261

6.7 Manufacturers' designations. Manufacturers' circuits which form a part of this specification are designated with an "X" as shown in table IV herein.

TABLE IV. Manufacturers' designations.

Device type	Circuit	
	A Texas Instruments	B Signetics Corp.
01	X	X

6.8 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:

Army - ER
Navy - EC
Air Force - 17

Preparing activity:
Air Force - 17

(Project 5962-0602-6)

Review activities:

Army - AR, MI
Navy - SH, OS
Air Force - 11, 19, 85, 99
DLA - ES

User activities:

Army - SM
Navy - AS, CG, MC

Agent:

DLA - ES